

## 1.3

# Points, Lines, and Planes

**Goal** Use postulates and undefined terms.

### VOCABULARY

**Undefined terms** A word, such as *point*, *line*, or *plane*, that is not mathematically defined using other known words, although there is a common understanding of what the word means.

**Point** A point has no dimension. It is represented by a small dot.

**Line** A line has one dimension. It extends without end in two directions. It is represented by a line with two arrowheads.

**Plane** A plane has two dimensions. It is represented by a shape that looks like a floor or wall. You have to imagine that it extends without end.

**Postulate** A postulate is a statement that is accepted without further justification.

**Collinear points** Collinear points are points that lie on the same line.

**Coplanar points** Coplanar points are points that lie on the same plane.

**Coplanar lines** Coplanar lines are lines that lie on the same plane.

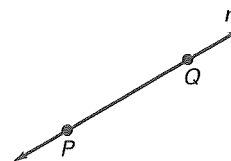
**Segment, Endpoints** A segment is part of a line that consists of two points, called *endpoints*, and all points on the line that are between the endpoints.

**Ray** The ray  $AB$  consists of the endpoint  $A$  and all points on  $AB$  that lie on the same side of  $A$  as  $B$ .

### POSTULATE 1: TWO POINTS DETERMINE A LINE

**Words** Through any two points there is exactly one line.

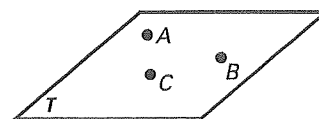
**Symbols** Line  $n$  passes through points  $P$  and  $Q$ .



### POSTULATE 2: THREE POINTS DETERMINE A PLANE

**Words** Through any three noncollinear points there is exactly one plane.

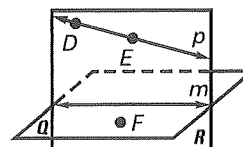
**Symbols** Plane  $T$  passes through points  $A$ ,  $B$ , and  $C$ .



#### Example 1 Name Points, Lines, and Planes

Use the diagram at the right.

- Name 3 points.
- Name 2 lines.
- Name 2 planes.



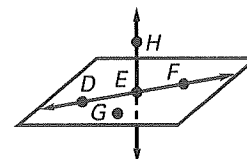
#### Solution

- a.  $\underline{D}$ ,  $\underline{E}$ , and  $\underline{F}$       b.  $\underline{m}$  and  $\underline{p}$       c.  $\underline{Q}$  and  $\underline{R}$

#### Example 2 Name Collinear and Coplanar Points

Use the diagram at the right.

- Name three points that are collinear.
- Name four points that are coplanar.
- Name three points that are not collinear.



#### Solution

- Points  $\underline{D}$ ,  $\underline{E}$ , and  $\underline{F}$  lie on the same line. So, they are collinear.
- Points  $\underline{D}$ ,  $\underline{E}$ ,  $\underline{F}$ , and  $\underline{G}$  lie on the same plane. So, they are coplanar.
- Points  $\underline{H}$ ,  $\underline{E}$ , and  $\underline{G}$  do not lie on the same line. There are many correct answers.

✔ **Checkpoint** Use the diagram shown.

1. Name two lines.

*Sample answer:  $n, m$*

2. Name two planes.

*$S, T$*

3. Name three points that are collinear.

*$C, D, E$*

4. Name three points that are not collinear.

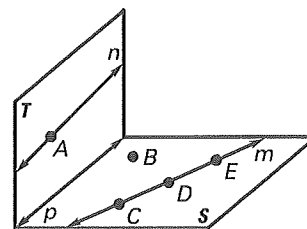
*Sample answer:  $B, C, D$*

5. Name four points that are coplanar.

*$B, C, D, E$*

6. Name two lines that are coplanar.

*$p$  and  $n$ , or  $p$  and  $m$*



**Follow-Up** Draw a diagram for each word.

### LINES, SEGMENTS, AND RAYS

Word	Symbol	Diagram
line	$\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$	
segment	$\overline{AB}$ or $\overline{BA}$	
ray	$\overrightarrow{AB}$	
	$\overrightarrow{BA}$	

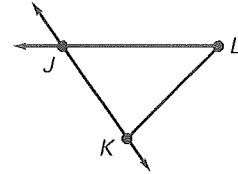
**Example 3** Draw Lines, Segments, and Rays

Draw three noncollinear points,  $J$ ,  $K$ , and  $L$ . Then draw  $\overleftrightarrow{JK}$ ,  $\overline{KL}$ , and  $\overrightarrow{LJ}$ .

**Solution**

Use the space at the right, and follow these steps.

1. Draw  $J$ ,  $K$ , and  $L$  so that they are not collinear. *Sample answer:*
2. Draw  $\overleftrightarrow{JK}$ .
3. Draw  $\overline{KL}$ .
4. Draw  $\overrightarrow{LJ}$ .



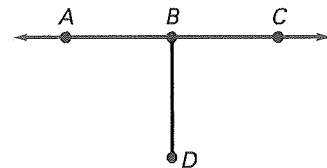
**Follow-Up** Use your drawing in Example 3 to complete the table.

	Line, segment, ray?	How many arrowheads?	Name any endpoints.
$\overleftrightarrow{JK}$	line	two	none
$\overline{KL}$	segment	none	$K, L$
$\overrightarrow{LJ}$	ray	one	$L$

**Checkpoint** Use the four points shown.

7. Draw  $\overleftrightarrow{AB}$  and  $\overleftrightarrow{AC}$ . Are the lines the same? Explain.

Yes.  $A$ ,  $B$ , and  $C$  are collinear.



8. Draw  $\overline{AC}$  and  $\overline{BD}$ . Are the segments the same? Explain.

No. They have different endpoints.

9. Draw  $\overrightarrow{CA}$  and  $\overrightarrow{CB}$ . Are the rays the same? Explain.

Yes. They have the same endpoint and direction.